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(54) **SOUND TRANSDUCER WITH VENTILATION STRUCTURE**

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(30) **Foreign Application Priority Data**

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(51) **Int. Cl.**

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H04R 9/06	(2006.01)
H04R 9/02	(2006.01)
H04R 1/28	(2006.01)

(52) **U.S. Cl.**

CPC ***H04R 1/02*** (2013.01); ***H04R 9/025*** (2013.01); ***H04R 9/06*** (2013.01); *H04R 1/2823* (2013.01)

(58) **Field of Classification Search**

CPC H04R 1/02; H04R 1/021; H04R 1/025; H04R 1/026; H04R 1/2823; H04R 1/2826; H04R 1/2807; H04R 1/2811; H04R 1/2819; H04R 9/025; H04R 9/027; H04R 9/041; H04R 9/045; H04R 9/06; H04R 9/022

USPC 381/412

See application file for complete search history.

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(57) **ABSTRACT**

The present invention discloses a sound transducer with a ventilation structure capable of securing a flow path of air introduced from within and outside of the sound transducer to the maximum. The sound transducer with a ventilation structure includes a frame, a magnetic circuit installed within the frame, a voice coil vibrating according to mutual electromagnetic force with the magnetic circuit upon receiving an electrical signal, a vibration plate vibrating according to vibrations of the voice coil to generate a sound, and a drain hole formed to be adjacent to the corner of the frame and allowing air to flow between the interior and exterior of the frame.

19 Claims, 5 Drawing Sheets

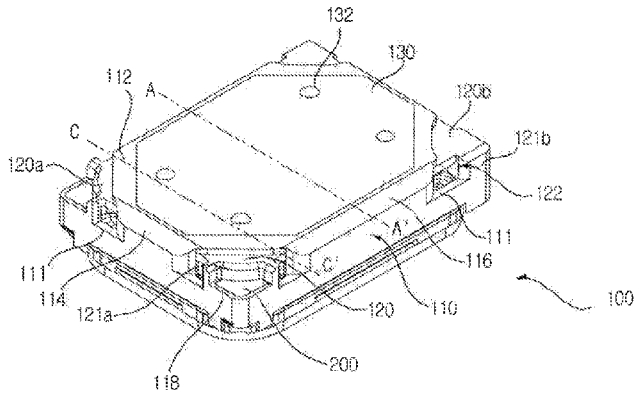


FIG. 1 (PRIOR ART)

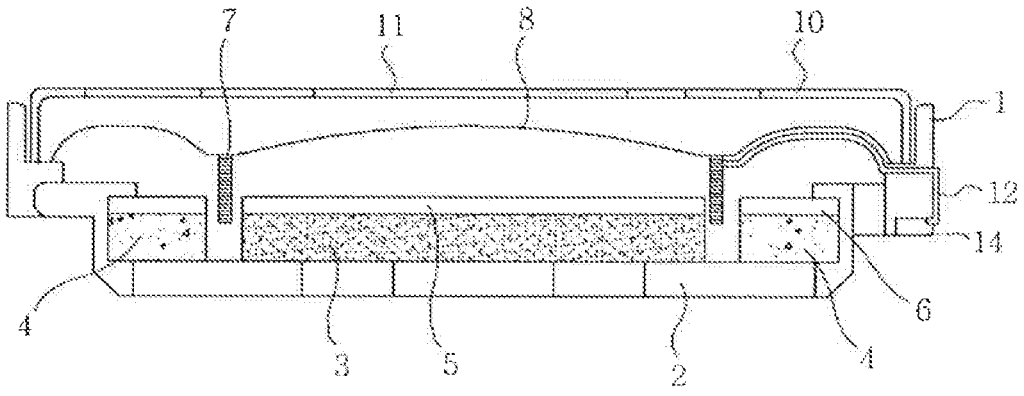


FIG. 2 (PRIOR ART)

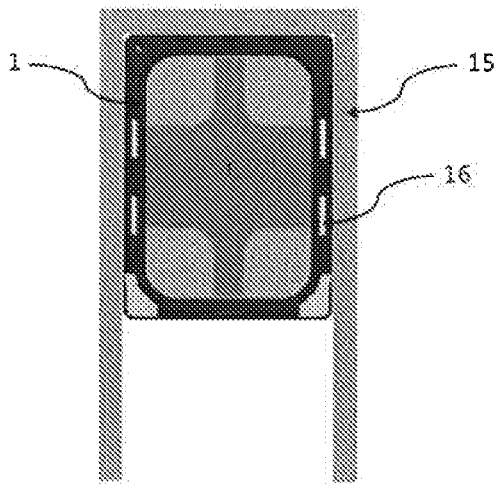


FIG. 3

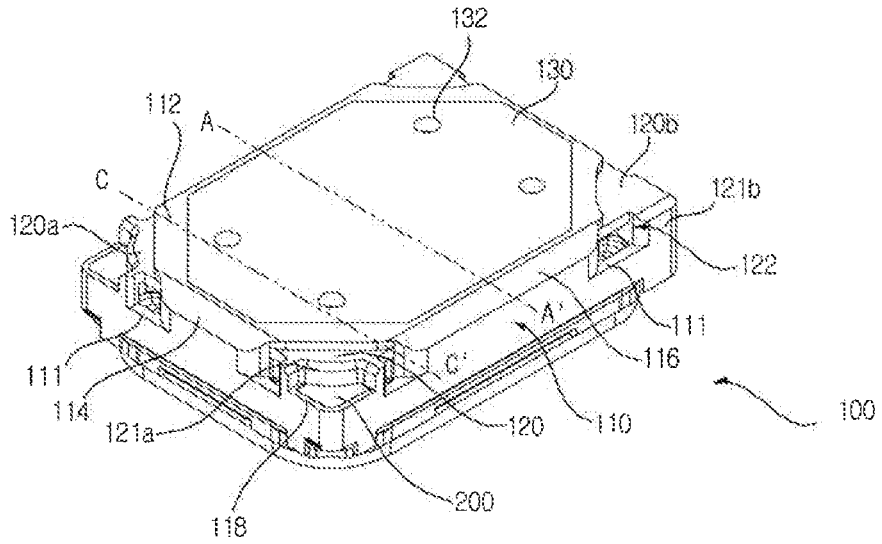

132
130
112
A
120b
C
121b
120a
122
A'
111
111
116
C'
114
121a
120
110
100
200
118

FIG. 4

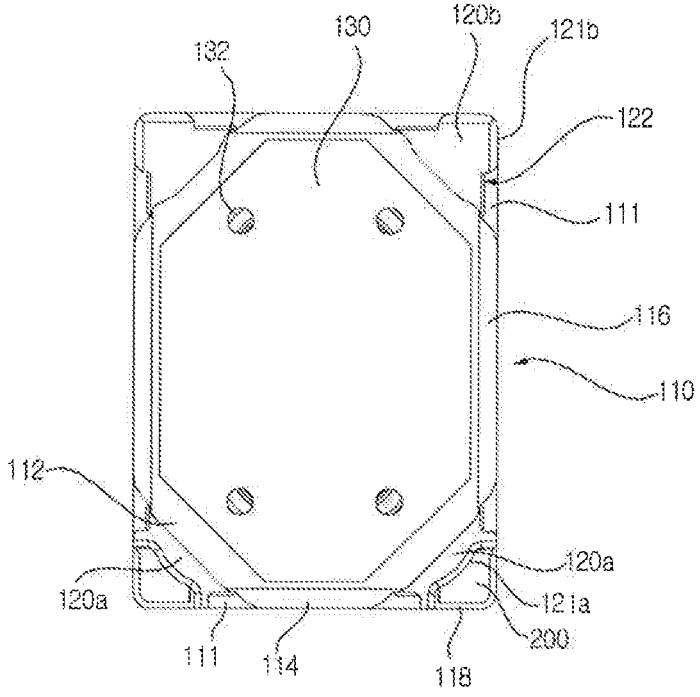

130
120b
121b
132
122
111
116
110
112
120a
120a
121a
200
111
114
118

FIG. 5

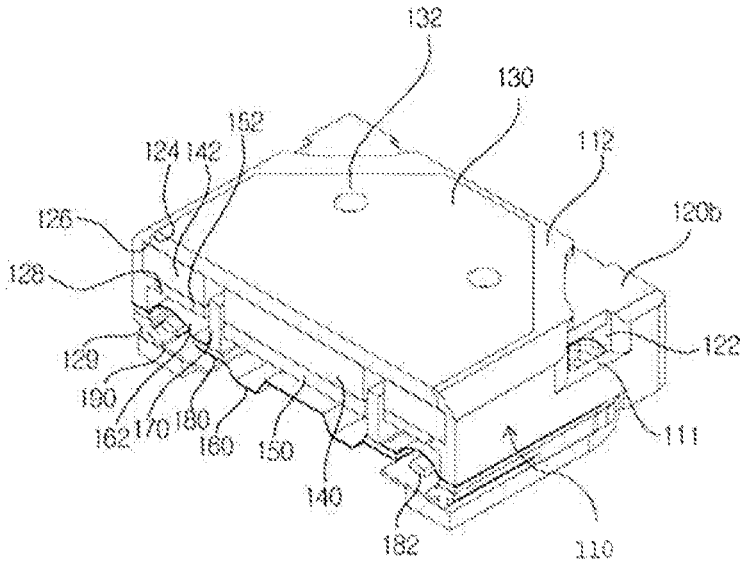

132
130
162
124
142
112
126
120b
128
122
129
190
162
170
180
160
150
140
111
182
110

FIG. 6

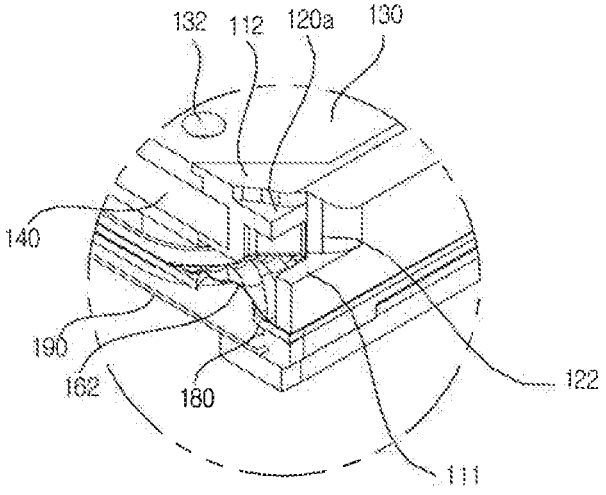

132
112
120a
130
140
190
162
180
122
111

FIG. 7

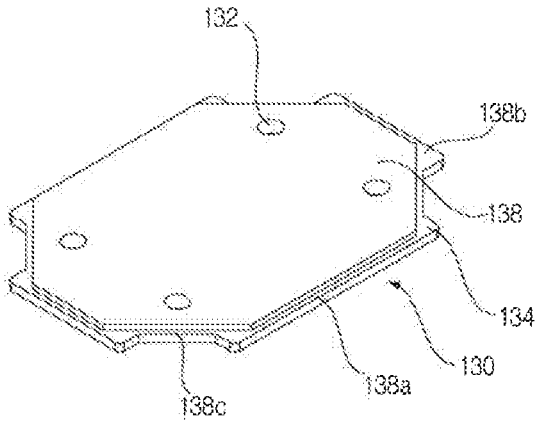


FIG. 8

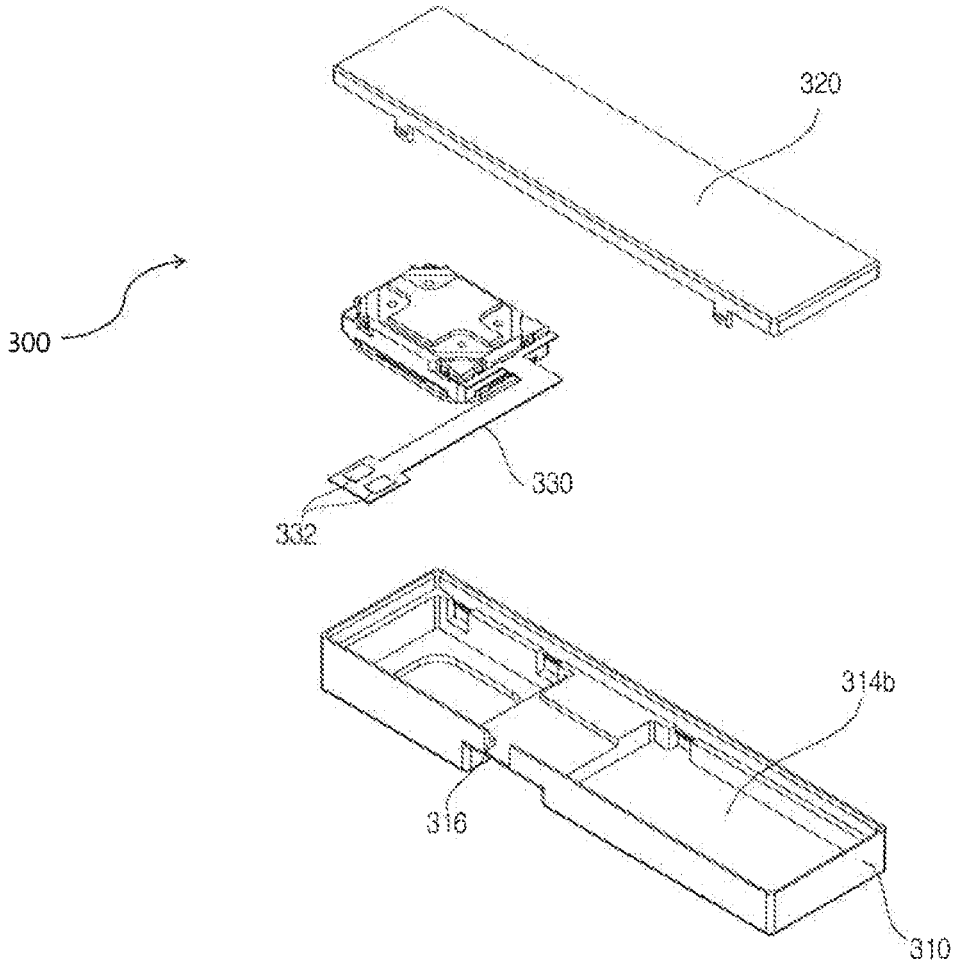
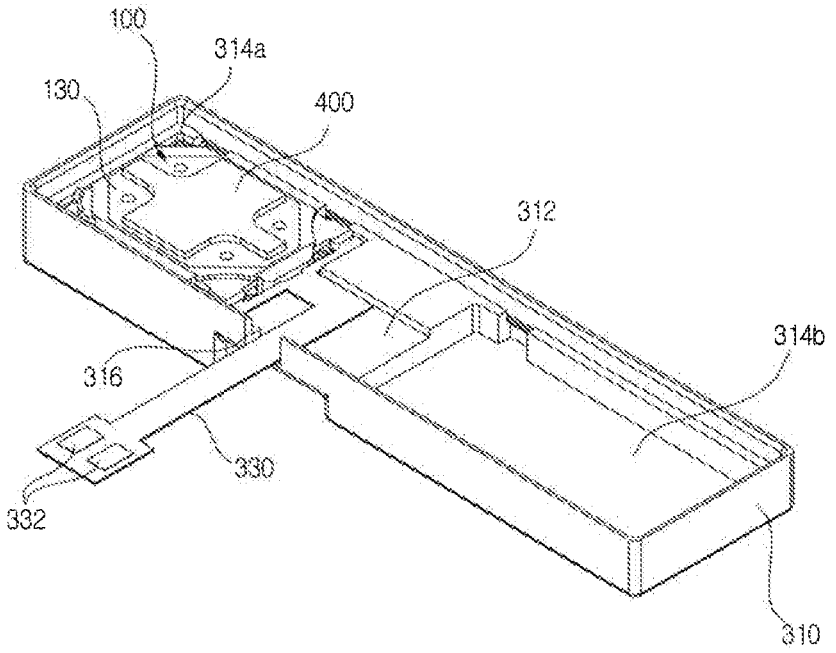


FIG. 9



SOUND TRANSDUCER WITH VENTILATION STRUCTURE

TECHNICAL FIELD

The present invention relates to a sound transducer, and more particularly, to a sound transducer with a ventilation structure capable of securing a flow path of air introduced from within and outside of the sound transducer to the maximum.

BACKGROUND ART

FIG. **1** is a cross-sectional view of a related art sound transducer.

As illustrated in FIG. **1**, a general sound transducer (speaker) includes a frame **1**, a yoke **2** insertedly installed within the frame **1**, an inner magnet **3** and an outer magnet **4** transmitting magnetic flux to the yoke **2** or receiving magnetic flux from the yoke **2**, respectively, an inner top plate **5** and an outer top plate **6** receiving magnetic flux from the inner magnet **3** or the outer magnet **4** and transmitting magnetic flux to a voice coil **7** at a right angle, respectively, the voice coil **7** having a portion inserted in a gap between the inner magnet **3** and the inner top plate **5** and the outer magnet **5** and the outer top plate **6**, a vibration plate **8** having the voice coil **7** attached to an inner side thereof and generating vibrations according to a vertical movement of the voice coil **7**, a projector **10** having a sound discharge hole **11** and protecting the vibration plate **8**, and the like.

FIG. **2** is a schematic view of an enclosure in which the sound transducer is installed. As illustrated in FIG. **2**, the related art sound transducer is insertedly installed in a space of an enclosure case **15**. A draft hole **16** is formed on a lateral surface of the frame **1** in a longer-axis direction, and thus, when the sound transducer is inserted in the enclosure case **16**, the draft hole **16** is in contact with a lateral surface of the case **15** and closed, restraining a smooth air flow. In this manner, the draft hole **16** of the related art sound transducer is formed in the longer side of the frame or in the vicinity of the center of a cross-section of the frame **1**.

In the case of the structure, a size (or a sectional area) of a magnetic circuit based on the yoke **2** and the outer magnet **4** is required to be reduced due to the formation position of the draft hole **16**.

DISCLOSURE OF THE INVENTION

An object of the present invention is to provide a sound transducer with a ventilation structure capable of increasing a degree of ventilation between an inner space and an outer space thereof or a degree of ventilation between an ambient space thereof and a resonance space of an enclosure.

Another object of the present invention is to provide a sound transducer with a ventilation structure capable of maximizing a magnetic circuit in size, while maintaining a ventilation space.

Another object of the present invention is to provide a sound transducer with a ventilation structure capable of forming a smooth air flow between the sound transducer and an inner space of a different device when the sound transducer is installed in the difference device.

Another object of the present invention is to provide a sound transducer with a ventilation structure capable of preventing an introduction of foreign objects through the ventilation structure.

According to an aspect of the present invention for achieving the above objects, there is provided a sound transducer with a ventilation structure, including: a frame; a magnetic circuit installed within the frame; a voice coil vibrating according to mutual electromagnetic force with the magnetic circuit upon receiving an electrical signal; a vibration plate vibrating according to vibrations of the voice coil to generate a sound; and a drain hole formed to be adjacent to the corner of the frame and allowing air to flow between the interior and exterior of the frame.

The drain hole may be formed in a position adjacent to the corner of the frame, relative to the center of a lateral surface of the frame in a longer axis direction.

The drain hole may be formed in a space between a yoke included in the magnetic circuit and the corner of the frame.

The yoke may include a longer side portion, a shorter side portion, and a connection portion connecting the longer side portion and the shorter side portion, and the drain hole may be formed in a space between the connection portion and the corner of the frame.

A horizontal blocking portion may be formed on an upper surface of the drain hole, and a lateral surface and a lower surface of the drain hole may be formed by a vertical blocking portion and a lateral surface of the frame.

A terminal unit formed to be stepped with respect to the horizontal blocking portion may be formed between the vertical blocking portion and the corner of the frame.

The horizontal blocking portion may be formed to be stepped with respect to the yoke.

A sloped portion may be formed between a lateral surface or the corner of the frame and the yoke.

A portion of the horizontal blocking portion may be formed inwardly, relative to a lateral portion of the frame, to allow a portion of the drain hole to face in an upward direction.

The longer side portion and the shorter side portion may have a linear shape, and the connection portion may have a round shape or may have a linear shape at a predetermined angle with respect to the longer side portion and the shorter side portion.

According to an embodiment of the present invention, a degree of ventilation between an inner space and an outer space of the sound transducer or a degree of ventilation between a peripheral space of the sound transducer and a resonance space of an enclosure can be increased.

Also, according to an embodiment of the present invention, since the magnetic circuit is maximized in size, while maintaining a ventilation space, sound pressure characteristics can be enhanced.

Also, according to an embodiment of the present invention, when the sound transducer is installed within a different device, the sound transducer can make air flow smoothly between the sound transducer and an inner space of the different device.

Also, according to an embodiment of the present invention, an introduction of foreign objects through the ventilation structure can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view of a related art sound transducer.

FIG. **2** is a schematic view of an enclosure in which the sound transducer of FIG. **1** is installed.

FIG. **3** is a perspective view of the sound transducer with a ventilation structure according to an embodiment of the present invention.

FIG. **4** is a plan view of the sound transducer of FIG. **3**.

FIG. **5** is a cross-sectional perspective view taken along line A-A' of FIG. **3**.

FIG. **6** is a partial cross-sectional perspective view taken along line C-C' of FIG. **3**.

FIG. **7** is a perspective view of a yoke **130** of FIG. **3**.

FIG. **8** is an exploded perspective view illustrating the sound transducer of FIG. **3** and an enclosure.

FIG. **9** is an assembled perspective view illustrating the sound transducer of FIG. **8** and the enclosure.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, a sound transducer with a ventilation structure according to an embodiments of the present invention will be described with reference to the accompanying drawings.

FIG. **3** is a perspective view of the sound transducer with a ventilation structure according to an embodiment of the present invention, FIG. **4** is a plan view of the sound transducer of FIG. **3**, FIG. **5** is a cross-sectional perspective view taken along line A-A' of FIG. **3**, and FIG. **6** is a partial cross-sectional perspective view taken along line C-C' of FIG. **3**.

In FIG. **3**, a sound transducer is illustrated as being reversed to describe a part having a ventilation structure in detail. The sound transducer **100** includes a frame **110**, a yoke **130** installed on top of the frame **110**, and a drain hole **122** formed in the corner of the frame **110**.

The frame **110** includes a first sloped portion **112** in contact with the yoke **130** to correspond to a shape of the yoke **130** and sloped toward the corner of the frame between the yoke **130** and the corner of the frame **110**, a second sloped portion **114** corresponding to the shape of the yoke and sloped toward a shorter side of the frame **110** between the yoke **130** and a lateral surface of the frame **110**, and a third sloped portion **116** corresponding to the shape of the yoke and sloped toward a longer side of the frame **110** between the yoke **130** and a lateral surface of the frame **110**.

Also, the drain hole **122** is formed on a laterals surface of the frame **110** in a lower portion of the first sloped portion **112** of the frame **110**. The frame **110** includes a first horizontal blocking portion **120***a* formed to be lower than the yoke **130** and/or the first sloped portion, namely, formed to be stepped, between the first sloped portion **112** and the corner of the frame **110** to prevent foreign objects, or the like, from an upper side from being introduced to the drain hole **122**, and a first vertical blocking portion **121***a* connected to the first horizontal blocking portion **120***a* in the corner of the frame **110** or between the first horizontal blocking portion **120***a* and the corner of the frame **110** to prevent foreign objects, or the like, from the corner (or in a lateral direction) from being introduced to the drain hole **122**. A pair of drain holes **122** are formed to be adjacent to each corner. The pair of drain holes **122** are connected to allow air to flow in different directions between the first horizontal blocking portion **120***a* formed on an upper surface, the first vertical blocking portion **121***a* formed on the lateral surface, and a lateral portion **111** of the frame **110** formed on the lateral surface and a lower surface. The frame **110** includes a terminal fixing portion **118** formed to be lower than the first horizontal blocking portion **120***a*, namely, formed to be stepped, in the corner of the frame or between the first vertical blocking portion **121***a* and the corner of the frame **110**, and connected to the first vertical blocking portion **121***a* to fix a terminal **200**. The terminal **200** is an element electrically connected to an element that transmits a conductor or any other electrical signal from an electronic device, and a soldering operation, or the like, is performed on an upper surface of the terminal **200**. In this case, in order to prevent foreign objects, or the like, from being inserted into the drain hole **122** during the soldering operation, the first vertical blocking portion **121***a* is formed to surround the terminal **200** and connect the lateral surface of the frame **110** in the longer-axis direction and the lateral surface of the frame **110** in the shorter-axis direction which are adjacent to each other.

Also, the drain hole **122** is formed on a lateral surface of the frame **110** in a lower portion of the first sloped portion **112** of the frame, in a corner region in which the terminal **200** is not formed, namely, in a region facing the region in which the terminal **200** is formed. The frame **110** includes a second horizontal blocking portion **120***b* formed to be lower than the yoke **130** and/or the first sloped portion **112**, namely, formed to be stepped, between the first sloped portion **112** and the corner of the frame **110** to prevent foreign objects, or the like, from an upper side from being introduced to the drain hole **122**, and a second vertical blocking portion **121***b* connected to the second horizontal blocking portion **120***b* in the corner of the frame **110** or between the second horizontal blocking portion **120***b* and the corner of the frame **110** to prevent foreign objects, or the like, from the corner (or in the lateral direction) from being introduced to the drain hole **122**. A pair of drain holes **122** are formed to be adjacent to each corner. The pair of drain holes **122** are connected to allow air to flow in different directions between the second horizontal blocking portion **120***b* formed on the upper surface, the second vertical blocking portion **121***b* formed on the lateral surface, and the lateral portion **111** of the frame **110** formed on the lateral surface and the lower surface.

As illustrated in FIG. **4**, the yoke **130** is installed on the frame **110**, and the drain hole **122** is formed in the vicinity of the frame **110**. Also, a through hole **132** is formed in the yoke **130**, and a voice coil **170** is installed below the through hole **132**. The through hole **132** is formed in the yoke **130** in a space in which the voice coil **170** is installed between an inner magnet **140** and an outer magnet **142** to serve as a drain hole.

As illustrated in FIG. **5**, the sound transducer **100** includes the yoke **130**, the inner magnet **140** and the outer magnet **142** transmitting magnetic flux to the yoke **130** or receiving magnetic flux from the yoke **130**, respectively, an inner top plate **150** and an outer top plate **152** receiving magnetic flux from the inner magnet **140** or the outer magnet **142** and transmitting the received magnetic flux to the voice coil **170** at a right angle, respectively, the voice coil **170** having a portion inserted in a gap between the inner magnet **140** and the inner top plate **150** and the outer magnet **142** and the outer top plate **152**, a vibration plate vibrating according to vibrations of the voice coil **170** to generate a sound, and including a central vibration plate **160** and a side vibration plate **152**, a suspension transmitting an electrical signal to the voice coil **170** and regulating vibrations of the vibration plate, a substrate **180** (e.g., a flexible printed circuit board (FPCB)), electrically connected to the terminal **200** that receives an electrical signal from an external terminal, and a protector **190** protecting components of the sound transducer.

In the frame **110**, a magnetic circuit including the yoke **130**, the inner and outer magnets **140** and **142**, and the inner and outer top plates **150** and **152** is installed in the center thereof. Thus, an empty space is provided in the center of the

frame **110** to allow the magnetic circuit to be installed therein. The magnetic circuit is installed within the frame **110** to maintain constant magnetic force in the space in which the voice coil **170** is positioned.

The frame **110** includes a yoke installation portion **124** in which the yoke **130** is fixedly installed, a magnet installation portion **126** in which the outer magnet **142** is fixedly installed, and a top plate installation portion **128** in which the outer top plate **152** is fixedly installed. The substrate **180** is insertedly installed in the lateral surface of the frame **110**, and a protector fixing unit **129** in which the projector **190** is fixedly installed is formed.

A vibration member in which the voice coil, **170**, the vibration plate, and the substrate **180** are attached to each other is installed on the frame **110**. The voice coil **170** is attached to an upper portion of the substrate **180**, and the side vibration plate **162** is attached to be spaced apart from the portion of the frame **170** to which the voice coil is attached. Also, the central vibration plate **160** is attached to a lower portion of the substrate **180**. The sound transducer is a device including the magnetic circuit and the vibration member formed within the frame **110** and in which the vibration member vibrates according to an electrical signal applied from the outside to generate a sound.

The voice coil **170** is bonded to the suspension unit **182** through a method such as soldering, or the like, and attached to the suspension unit **182** by a tape or any other adhesive. The suspension unit **182** allows the vibration plate to vibrate only in a vertical direction, preventing an occurrence of abnormal vibration such as divided vibration or partial vibration, thereby enhancing sound quality. The vibration plate includes the central vibration plate **160** positioned in a central portion and the side vibration plate **162** positioned in an outer portion of the central vibration plate **160** and having an annular shape. The central vibration plate **160** has a downwardly protruded dome-like shape, and the side vibration plate **162** has an upwardly protruded dome-like shape.

FIG. **6** is a partial cross-sectional perspective view taken along line C-C' of FIG. **3**. As illustrated in FIG. **6**, the second horizontal blocking portion **120***b* prevents an introduction of foreign objects from an upper side, and the lateral portion **111** of the frame **110** prevents an introduction of foreign objects in the lateral surface. Accordingly, an air flow rises from an upper side of the vibration plate **162** along the inner side of the lateral portion **111** and moves to the outside through the drain hole **122**.

FIG. **7** is a perspective view of a yoke **130** of FIG. **3**. The yoke **130** illustrated in FIG. **7** includes a rim portion **134** insertedly fixed to the frame **110** and a base portion **138** positioned within the rim portion **134** and exposed to the outside of the frame **110**. The base portion **138** includes a longer axis portion **138***a* formed in a longer axis direction, a shorter axis portion **138***b* formed in a shorter axis direction, and a connection portion **138***c* connecting the longer axis portion **138***a* and the shorter axis portion **138***b*. The longer axis portion **138***a* is consistent with the longer axis direction of the frame **110** and has a linear shape, and the shorter axis portion **138***b* is consistent with the shorter axis direction and has a linear shape. As illustrated, the connection portion **138***c* may be chamfered to have a linear shape so as to be connected to the longer axis portion **138***a* and the shorter axis portion **138***b* at an angle smaller than 180 degrees. Alternatively, the connection portion **138***c* may be processed to be rounded to have a round shape. As illustrated, the connection portions **138***c* may be formed to correspond to four corners of the frame **110**, or at least two or more connection portions **138***c* may be formed.

Also, in order to correspond to the shape of the yoke **130**, shapes of the outer magnet **142** and the outer top plate **152** should be altered.

Referring to FIGS. **4** and **7**, the drain hole **122** is formed to be adjacent to the corner of the frame **110**, rather than to the center of the lateral surface of the frame **110** in the longer axis direction. In particular, the drain hole **122** is formed in a space between the yoke **130** and the corner of the frame **110**, allowing the magnetic circuit to have a maximum size. In particular, the drain hole **122** is formed in a space between a front side of the connection portion **138***c* and the corner of the frame **110**.

Referring to FIGS. **3** and **4**, portions of the first and second horizontal blocking portions **120***a* and **120***b* constituting an upper portion of the through hole **122** are formed inwardly, relative to the lateral surface of the frame **110**. Accordingly, a portion of the through hole **122** faces in an upward direction of the frame **110**, allowing air to flow even in the upward direction of the frame **110**, as well as to the lateral surface of the frame **110**. Referring to FIG. **4**, a portion of the drain hole **122** is seen in the plan view of the sound transducer **100**.

FIG. **8** is an exploded perspective view illustrating the sound transducer of FIG. **3** and an enclosure, and FIG. **9** is an assembled perspective view illustrating the sound transducer of FIG. **8** and the enclosure.

An enclosure **300** includes a pair of accommodation recesses **314***a* and **314***b* allowing the sound transducer **100** to be insertedly installed therein, or maintained as being empty, a connection portion **316** connecting the pair of accommodation recesses **314***a* and **314***b* and allowing an FPCB connection portion **330** to be placed thereon, a case **310** having a through recess **316** allowing the FPCB connection portion **330** to penetrate therethrough outwardly, and an upper cover **320** covering a resonance space within the enclosure case **310**. The accommodation recess **314***b*, in which the sound transducer **100** is not inserted, is a resonance space.

A lateral surface of the frame **110** of the sound transducer **100** is installed to be in contact with a lateral surface of the accommodation recess **314***a*.

The FPCB connection portion **330** includes a pair of reception terminals **332** receiving an electrical signal from an electrical device and a pair of pattern portions (not shown) electrically connecting the pair of terminals **200** of the sound transducer **100** and the reception terminals **332**.

When the sound transducer **100** is insertedly installed in the enclosure case **310**, a buffering member **400** may be coupled to an upper surface and/or lower surface of the frame **110**.

As for an air flow, air passing through the drain hole **122** flows to a front side of the lateral surface of the frame **110** and a portion thereof moves upwardly. Subsequently, air moves along an upper surface of the second horizontal blocking portion **120***b* toward the resonance space through an upper surface of the sloped portion **116** or **112**. Also, air moves along an upper surface of the first horizontal blocking portion **120***a* or the sloped portion **112** toward the resonance space.

Also, a degree of air flow (a degree of ventilation) between the inner space of the sound transducer **100** and an outer space as the resonance space within the enclosure case **310** can be enhanced through the drain hole **122** formed in the sound transducer **100**.

As described above, the enhancement of an air flow between the interior of the sound transducer **100** and the outer space through the drain hole **122** and the through hole

132 has been known to improve wideband sound pressure characteristics following a primary resonance band (e.g., 1~4 kHz) of the sound transducer **100** (please see pages 115 to 122, third issue (No.3), volume 26, article of The Acoustical Society of Korean, 2007).

In an embodiment of the present invention, air can flow smoothly between the interior of the sound transducer **100** and an outer space without reducing a size of the magnetic circuit of the sound transducer **100**.

While the present invention has been shown and described in connection with the embodiments, it will be apparent to those skilled in the art that modifications and variations can be made without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A sound transducer with a ventilation structure, the sound transducer comprising:

a frame;

a magnetic circuit installed within the frame, including a yoke, inner and outer magnets, and inner and outer top plates;

a voice coil vibrating according to mutual electromagnetic force with the magnetic circuit upon receiving an electrical signal;

a vibration plate vibrating according to vibrations of the voice coil to generate a sound; and

a drain hole formed to be adjacent to a corner of the frame and allowing air to flow between the interior and exterior of the frame,

wherein the drain hole is formed in a space between the yoke and the outer magnet included in the magnetic circuit and the corner of the frame.

2. The sound transducer as claimed in claim **1**, wherein the drain hole is formed in a position adjacent to the corner of the frame, relative to the center of a lateral surface of the frame in a longer axis direction.

3. The sound transducer as claimed in claim **1**, wherein the yoke comprises a longer side portion, a shorter side portion, and a connection portion connecting the longer side portion and the shorter side portion, and the drain hole is formed in a space between the connection portion and the corner of the frame.

4. The sound transducer as claimed in claim **1**, wherein a horizontal blocking portion is formed on an upper surface of the drain hole, and a lateral surface and a lower surface of the drain hole are formed by a vertical blocking portion and a lateral surface of the frame.

5. The sound transducer as claimed in claim **2**, wherein a horizontal blocking portion is formed on an upper surface of the drain hole, and a lateral surface and a lower surface of the drain hole are formed by a vertical blocking portion and a lateral surface of the frame.

6. The sound transducer as claimed in claim **1**, wherein a horizontal blocking portion is formed on an upper surface of the drain hole, and a lateral surface and a lower surface of the drain hole are formed by a vertical blocking portion and a lateral surface of the frame.

7. The sound transducer as claimed in claim **3**, wherein a horizontal blocking portion is formed on an upper surface of the drain hole, and a lateral surface and a lower surface of the drain hole are formed by a vertical blocking portion and a lateral surface of the frame.

8. The sound transducer as claimed in claim **4**, wherein a terminal unit formed to be stepped with respect to the horizontal blocking portion is formed between the vertical blocking portion and the corner of the frame.

9. The sound transducer as claimed in claim **6**, wherein a terminal unit formed to be stepped with respect to the horizontal blocking portion is formed between the vertical blocking portion and the corner of the frame.

10. The sound transducer as claimed in claim **7**, wherein a terminal unit formed to be stepped with respect to the horizontal blocking portion is formed between the vertical blocking portion and the corner of the frame.

11. The sound transducer as claimed in claim **4**, wherein the horizontal blocking portion is formed to be stepped with respect to the yoke.

12. The sound transducer as claimed in claim **7**, wherein the horizontal blocking portion is formed to be stepped with respect to the yoke.

13. The sound transducer as claimed in claim **1**, wherein a sloped portion is formed between a lateral surface or the corner of the frame and the yoke.

14. The sound transducer as claimed in claim **1**, wherein a sloped portion is formed between a lateral surface or the corner of the frame and the yoke.

15. The sound transducer as claimed in claim **3**, wherein a sloped portion is formed between a lateral surface or the corner of the frame and the yoke.

16. The sound transducer as claimed in claim **4**, wherein a portion of the horizontal blocking portion is formed inwardly, relative to a lateral portion of the frame, to allow a portion of the drain hole to face in an upward direction.

17. The sound transducer as claimed in claim **6**, wherein a portion of the horizontal blocking portion is formed inwardly, relative to a lateral portion of the frame, to allow a portion of the drain hole to face in an upward direction.

18. The sound transducer as claimed in claim **7**, wherein a portion of the horizontal blocking portion is formed inwardly, relative to a lateral portion of the frame, to allow a portion of the drain hole to face in an upward direction.

19. The sound transducer as claimed in claim **3**, wherein the longer side portion and the shorter side portion have a linear shape, and the connection portion has a round shape or a linear shape at a predetermined angle with respect to the longer side portion and the shorter side portion.

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